We claim:

1. A method for designing a filter for multiple access communications system which minimizes crosstalk between channels comprising the step of identifying signals having a property by which the autocorrelation function associated with said signals decay rapidly from the central lobe, that is, at a higher than 1/x rate which is typical of a wavelength division multiplexing communications system.

2. A method of designing a filter for a multiple access communications system which minimizes crosstalk between channels comprising the step of identifying signals s2(t) having a first property by which the autocorrelation function associated with said s2(t) signals decay rapidly from the central lobe, that is, at a higher than 1/x rate which is typical of a wavelength division multiplexing communications system and having a second property in which the zero points of the autocorrelations function have high order multiplicities.

3. The method of claim 2 further comprising the steps of:

(a) choosing a signal s(t) which is periodically orthogonal to its translates;

(b) determining a first autocorrelation function associated with s(t);

(c) denoting the Fourier transform of s(t) to be S(f);

(d) denoting the Fourier transform of said first autocorrelation function of s(t)
as H(f);

(e) determining said Fourier transform, H(f), of said first autocorrelation function of s(t) in accordance with the equation $H(f) = |S(f)|^2$;

(f) forming the Fourier transform of a second autocorrelation function by convolving H(f) with itself;

(g) determining said convolution according to the equation $G(f) = \mathrm{Conv}(H(f), H(f))$;

(h) determining the square root of G(f);

(i) denoting said square root of G(f) as S2(f); and

(j) taking the inverse Fourier transform of S2(f).

4. The method of claim 2 wherein s(t) is a sinc function.

5. The method of claim 2 wherein s(t) is a signal whose autocorrelation function is a Coifman Meyer window.

6. The method of claim 2 wherein s(t) is selected from any variety of wavelets at any individual scale.

7. The method of claim 2 wherein s(t) is any function whose translates are periodically orthogonal to s(t).

8. A method of filtering a signal of a communications system which minimizes crosstalk between channels comprising the steps of:

(a) creating a signal from a source of modulated pulses;

(b) filtering said signal of modulated pulses with a filter designed in accordance with the method specified in claim 2;

(c) coupling said filtered modulated pulses onto the transmission channel for said communication system;

(d) receiving said coupled filtered modulated pulses from said transmission channel with a matched filter designed in accordance with the method specified in
claim 2;

(e) detecting said signal from said matched filter.

9. The method of claim 8 wherein said source of modulated pulses produces signals which are relatively stable in time.

10. The method of claim 8 wherein said source of modulated pulses produces signals which have known variants.

11. The method of claim 8 wherein said filter is a fiber optic filter.

12. The method of claim 8 wherein said filter comprises in-fiber gratings.

13. The method of claim 8 wherein said filter comprises Bragg gratings.

14. The method of claim 8 wherein said filter comprises thin film filters.

15. The method of claim 8 wherein said filter comprises spatial light modulation filters.

16. The method of claim 8 wherein said matched filter searches for said signal that was originally transmitted.

17. The method of claim 8 wherein said filter is specifically designed for

said signals.

18. The method of claim 8 wherein said matched filter is specifically designed for said signal.

19. A method of filtering a signal of a communications system which minimizes crosstalk between channels comprising the steps of:

(a) creating a signal from a source of modulated pulses;

(b) filtering said signal of modulated pulses with a filter designed in accordance with the method specified in claim 6;

(c) coupling said filtered modulated pulses onto the transmission channel for said communication system;

(d) receiving said coupled filtered modulated pulses from said transmission channel with a matched filter designed in accordance with a method for designing a filter for multiple access communications system which minimizes crosstalk between channels comprising the step of identifying signals having a property by which the autocorrelation function associated with said signals decay rapidly from the central lobe, that is, at a higher than 1/x rate which is typical of a wavelength division multiplexing communications system.

(e) detecting said signal from said matched filter.

20. The method of claim 19 wherein said source of modulated pulses produces signals which are relatively stable in time.

21. The method of claim 19 wherein said source of modulated pulses produces signals which have known variants.

22. The method of claim 19 wherein said filter is a fiber optic filter.

23. The method of claim 19 wherein said filter comprises in-fiber gratings.

24. The method of claim 19 wherein said filter comprises Bragg gratings.

25. The method of claim 19 wherein said filter comprises thin film filters.

26. The method of claim 19 wherein said filter comprises spatial light modulation filters.

27. The method of claim 19 wherein said matched filter searches for said signal that was originally transmitted.

28. The method of claim 19 wherein said filter is specifically designed for

said signals.

29. The method of claim 19 wherein said matched filter is specifically designed for said signal.

30. An electromagnetic matched filter based multiple access system for a communications system which minimizes crosstalk between channels comprising

(a) a source of modulated pulses from a digital data stream;

(b) a first filter for shaping the modulated pulse into a desired pulse for transmission across the communication medium;

(c) a transmission medium which is accurately modeled;

(d) a second filter which is matched to the pulse which exits the communications medium; and

(e) a detector which converts the modulated pulse stream into the original digital data stream.

31. The electromagnetic matched filter based multiple access system of claim 30 wherein said first and second filters are identical.

32. The electromagnetic matched filter based multiple access system of claim 30 wherein said first filter is designed in accordance with a method comprising the step of identifying signals s2(t) having a first property by which the autocorrelation function associated with said s2(t) signals decay rapidly from the central lobe, that is, at a higher than 1/x rate which is typical of a wavelength division multiplexing communications system and having a second property in which the zero points of the autocorrelations function have high order multiplicities.

33. The electromagnetic matched filter based multiple access system of claim 32 wherein s(t) is any function whose translates are periodically orthogonal to s(t).

34. The electromagnetic matched filter based multiple access system of claim 30 wherein said second filter is designed in accordance with a method comprising the step of identifying signals s2(t) having a first property by which the autocorrelation function associated with said s2(t) signals decay rapidly from

the central lobe, that is, at a higher than 1/x rate which is typical of a wavelength division multiplexing communications system and having a second property in which the zero points of the autocorrelations function have high order multiplicities.

35. The electromagnetic matched filter based multiple access system of claim 34 wherein s(t) is any function whose translates are periodically orthogonal to s(t).

36. The electromagnetic matched filter based multiple access system of claim 30 wherein said first filter is designed in accordance with a method comprising the steps of:

(a) choosing a signal s(t) which is periodically orthogonal to its translates;

(b) determining a first autocorrelation function associated with s(t);

(c) denoting the Fourier transform of s(t) to be S(f);

(d) denoting the Fourier transform of said first autocorrelation function of s(t)
as H(f);

(e) determining said Fourier transform, H(f), of said first autocorrelation function of s(t) in accordance with the equation $H(f) = |S(f)|^2$;

(f) forming the Fourier transform of a second autocorrelation function by convolving H(f) with itself;

(g) determining said convolution according to the equation $G(f) = \mathrm{Conv}(H(f), H(f))$;

(h) determining the square root of G(f);

(i) denoting said square root of G(f) as S2(f); and

(j) taking the inverse Fourier transform of S2(f).

37. The electromagnetic matched filter based multiple access system of claim 30 wherein said first filter is designed in accordance with a method comprising the steps of:

(a) creating a signal from a source of modulated pulses;

(b) filtering said signal of modulated pulses with a filter designed in accordance with the method specified in claim 2;

(c) coupling said filtered modulated pulses onto the transmission channel for said communication system;

(d) receiving said coupled filtered modulated pulses from said transmission channel with a matched filter designed in accordance with the method specified in
claim 2;

(e) detecting said signal from said matched filter.